Geographic Variation in Uterine Cancer Incidence in Connecticut

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UNEQUAL RATES of uterine cancer incidence have been observed between different countries, different sections of the same country, and different districts of single cities. These differentials appear to be greater for cervical cancer than for cancer of the uterine corpus. Geographic variations in uterine cancer incidence are associated with local variations in population composition and concentration and with industrial and economic conditions, and it has been suggested that factors in the physical environment may play a role in determining the incidence of cancer of the uterus. Racial and ethnic characteristics, socioeconomic levels, marital status, and other factors seem to be related to the incidence of cancer of the uterus, and these factors vary from one area to another.

Interrelationships among these factors have made it difficult to pinpoint any specific etiological agents by describing groups of women among whom cancer of the cervix or corpus occur with notable frequency or infrequency. However, comparisons of incidence rates of uterine cancer in small geographic areas with populations of known characteristics may contribute to the definition of profitable areas for research. In the present study, uterine cancer incidence risks for the 169 Connecticut towns have been calculated and their relation to several factors examined.

The basic data for the study were obtained from the tumor registry maintained by the Connecticut State Department of Health, which collects information on malignant tumors of all sites from hospitals and tumor clinics throughout the State, and from death certificates of Connecticut residents. The criteria for inclusion of cases in this study were:

1. The condition was diagnosed and reported as a malignant neoplasm.
2. The primary site was the uterine cervix or corpus, exclusive of chorionic tumors and carcinomas in situ.
3. The patient was a resident of Connecticut at the time of diagnosis.
4. The diagnosis of uterine cancer was first made during the period 1935–51.

It is thought that nearly all cases meeting these criteria have been reported to the registry. Of the 6,220 cases included in the study, 5,366, or 86 percent, were reported by hospitals; of these 92 percent were diagnosed on the basis of microscopic examination of tissue.

There were 805 cases, most of them reported by death certificate only, described as "cancer of the uterus," with site unspecified. Since a study of reporting practices and internal statistical evidence indicates that this designation has commonly meant cancer of the uterine corpus, these cases have been included with

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corpus throughout this paper. While some error is undoubtedly introduced by this practice, it is thought to be less than that which would be introduced by the exclusion or other classification of the unspecified cases. Residence, age, and survival, the only items of case information used here, have been checked and seem to have been reported accurately.

Geography and Population

Connecticut is divided into 169 towns (townships). Some are entirely rural or contain only small villages; others contain large cities.

Connecticut ranks fourth among the States in population density, with an estimated population in 1943 of 1,742,502, or 356 persons per square mile. During the period 1935–51 the nonwhite population constituted less than 3 percent of the total population, a group too small to be considered separately. Of greater numerical significance is the group of foreign-born whites, which in 1910 represented 30 percent of the total population. Although the relative size of this group has declined since that time, the foreign-born and their children still constitute a large segment of the population, especially in the older age groups. Throughout the study period the two largest groups of foreign-born were the Italian, comprising nearly 25 percent, and the Polish, comprising about 12 percent of the total foreign-born (*1,2*). Ethnic group data for the Connecticut population have not been tabulated in sufficient detail to permit their use in a study of the distribution of cancer risks among towns. However, the available evidence does suggest that local variations in cancer incidence rates may be associated with local variations in concentration of foreign-stock populations (*3*).

Methods

The incidence data given here are based on population estimates for 1943, the midpoint of the study period. Age- and sex-specific estimates were calculated by arithmetic interpolation from U.S. Bureau of the Census publications for 1940 and 1950. Age-specific incidence rates for cancer of the uterine cervix and corpus (table 1) were calculated for the State as a whole. "Expected" numbers of cervical and corpus cancer cases for the various towns were then derived by applying these State rates to the 1943 age-specific female population of each town. This method of calculating expected numbers of cancers adjusts for variations due to differences in age distribution; the ratio of observed to expected cases can thus be used for comparisons of risks between areas with different age distributions.

Indirect age-adjusted incidence rates for groups of towns could be calculated by multiplying the ratio of observed to expected cases for each area by the crude rates for the entire State (20.7 per 100,000 for cervix; 19.4 per 100,000 for corpus). Therefore, comparative statements about the incidence of cancer in different areas refer to two equivalent relationships: that between ratios of observed to expected cases and that between age-adjusted incidence rates for the areas.

Gross Geographic Patterns

Although the observed and expected numbers of cases were nearly equal for many towns, for the purpose of gross comparison each town was

Table 1. Reported uterine cancer cases and incidence rates, 1935–51, and estimated female population, 1943, Connecticut, by age

Age (years)	Estimated female population	Reported cases [1]		Age-specific annual incidence rates [2]	
		Cervix	Corpus	Cervix	Corpus
All ages	911, 148	3, 210	3, 010	20. 72	19. 43
0–14	195, 567	0	0	. 00	. 00
15–24	150, 895	11	10	. 43	. 39
25–34	153, 687	185	37	7. 08	1. 42
35–44	133, 929	713	217	31. 32	9. 53
45–54	115, 392	887	705	45. 22	35. 94
55–64	83, 591	817	922	57. 49	64. 88
65 and over	78, 087	597	1, 119	44. 97	84. 30

[1] Two cases of cervical cancer and four cases of corpus cancer for which age of the patient is unknown are distributed according to the distribution of cases in patients of known age.

[2] Average annual age-specific incidence rates per 100,000 females for the 17-year period, based on 1943 population estimates.

labeled either "high" or "low," as the ratio was greater or less than unity. The maps show that for neither cervix nor corpus do the "high" or "low" towns form an obvious band or cluster, although there are several suggestive groupings. Therefore, common geologic, geographic, and climatologic factors which might affect the populations of several contiguous towns do not seem to play an important role in the incidence variations among towns. However, such factors may affect cancer incidence rates within single towns or may influence incidence rates in the State as a whole.

The maps also permit an indirect check on the completeness of reporting of malignant uterine neoplasms. Since the southwest tip of Connecticut is close to New York City, and the northeast corner is not far from Boston, it might be expected that substantial numbers of patients from these areas would go to hospitals outside the State and would not be reported to the registry. The observed geographic patterns of high and low incidence rates for corpus cancer do not support this hypothesis. Although the extreme southwestern town of Connecticut had a significantly low incidence of cervical cancer, this is in keeping with its population and socioeconomic characteristics. Further analysis shows that many patients reported to have uterine cancer were in fact referred to medical centers in New York or Boston for treatment,

Incidence of uterine cancer in Connecticut, by towns

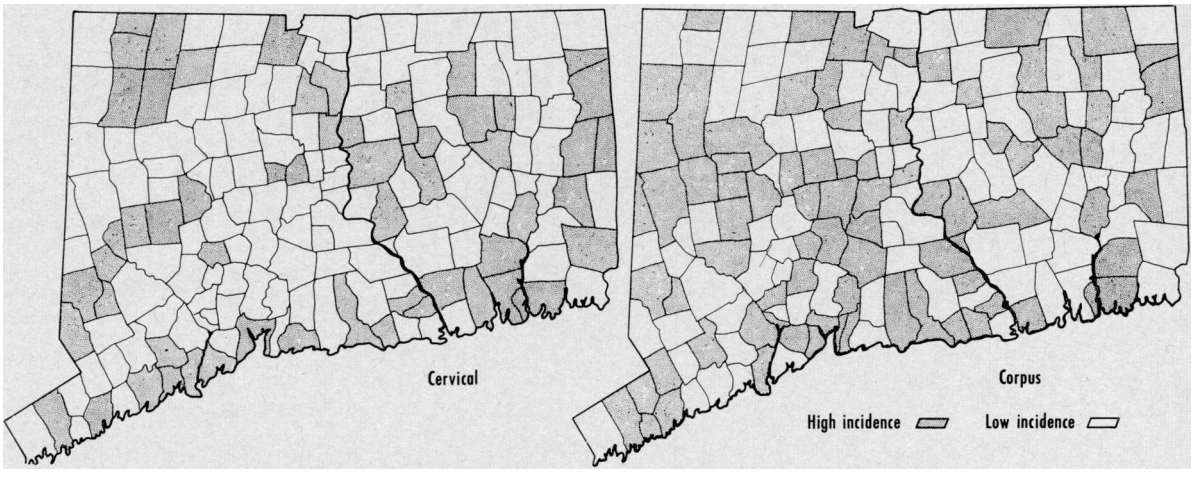

Table 2. Observed and expected numbers of uterine cancers in Connecticut, by metropolitan status of towns, 1935–51

Town status	Number of towns	Cervix [1]			Corpus [2]		
		Observed	Expected	Ratio O/E [3]	Observed	Expected	Ratio O/E [3]
Total	169	3,210	3,210.0	1.00	3,010	3,010.0	1.00
Metropolitan [4]	54	2,188	2,157.5	1.01	1,957	1,994.5	.98
Bridgeport	7	440	402.7	1.09	351	368.7	.95
Hartford-New Britain	24	920	924.6	1.00	825	852.1	.97
New Haven	13	606	571.3	1.06	547	537.0	1.02
Waterbury	10	222	258.9	.86	234	236.7	.99
Nonmetropolitan	115	1,018	1,052.0	.97	1,052	1,016.0	1.04

[1] Four cases for which residence of patient is unknown excluded from distribution by towns but included in expected value and total.

[2] One case for which residence of patient is unknown excluded from distribution by towns but included in expected value and total.

[3] Ratio of observed to expected cases.

[4] Included wholly or partially in metropolitan districts as defined by the Census Bureau for the 1940 Census of Population.

but only after they had been admitted to local hospitals for biopsy or other diagnostic procedures.

Population Concentration

An association of high population concentration with high incidence rates for cervical cancer and, in some cases, with high incidence of cancer of the uterine corpus has been noted in England and Wales (*4*), Finland (*5*), Denmark (*6*), Iowa (*7*), and New York State (*8*). This association has also been demonstrated in previous reports from the Connecticut Tumor Registry for a sample of towns (*9*), and for metropolitan versus nonmetropolitan areas (*10*).

In the 1940 population census metropolitan districts were defined for each city of 50,000 or more, two or more such cities sometimes being in one district (*11,12*). The general plan was to include in each district the central city or cities and the contiguous surrounding area having 150 or more inhabitants per square mile. A metropolitan district is thus not a political unit but is rather an area, including all the thickly settled territory in and around a city or group of cities, and tends to have common economic and social characteristics.

The 54 metropolitan towns, those wholly or partially included in a metropolitan district, lie in a band which extends from the western portion of the Connecticut shore northward into the central part of the State and which contains most of Connecticut's densely settled areas. Thirty-eight (70 percent) of the 54 metropolitan towns had low incidence rates for cervical cancer, while 26 (48 percent) had low incidence rates for corpus cancer.

As shown in table 2, there was no marked differential between metropolitan and nonmetropolitan towns for either type of uterine cancer. The ratio of observed to expected numbers of cervical cancer cases for the metropolitan towns was 1.01; for nonmetropolitan towns, 0.97. With one exception, Waterbury, the ratios for individual metropolitan districts were close to unity. The difference in corpus cancer incidence between metropolitan and nonmetropolitan towns was also very small.

Although the metropolitan districts generally comprise the State's contiguous areas of relatively dense population, this grouping of towns can conceal real and important differences in uterine cancer incidence among various parts of high population areas. As shown below, metropolitan districts do not seem to be satisfactory units for measuring the effect of population concentration, since high incidence rates for cervical cancer in the central cities seem to be balanced by low rates in the surrounding suburban areas.

The relation between incidence of uterine cancer and population size is shown in table 3.

Table 3. Observed and expected numbers of uterine cancers in Connecticut, by population of towns, 1935–51

Population of towns	Number of towns	Cervix [1]			Corpus [2]		
		Observed	Expected	Ratio O/E [3]	Observed	Expected	Ratio O/E [3]
Total	169	3,210	3,210.0	1.00	3,010	3,010.0	1.00
Rural	83	146	211.4	0.69	213	211.0	1.01
0–999	30	24	36.3	.66	37	37.1	1.00
1,000–2,499	53	122	175.1	.70	176	173.9	1.01
Urban	86	3,060	2,998.1	1.02	2,796	2,799.5	1.00
2,500–4,999	26	138	189.8	.73	191	185.7	1.03
5,000–19,999	39	670	677.9	.99	649	640.8	1.01
20,000–49,999	15	813	867.2	.94	790	813.6	.97
50,000 and over	6	1,439	1,263.2	1.14	1,166	1,159.4	1.01

[1] Four cases for which residence of patient is unknown excluded from distribution by towns but included in expected value and total.

[2] One case for which residence of patient is unknown excluded from distribution by towns but included in expected value and total.

[3] Ratio of observed to expected cases.

The incidence of cervical cancer in the six largest towns exceeded that in the rest of the State by 25 percent, and exceeded the incidence in rural towns by 65 percent. For corpus cancer, the corresponding differences were negligible. Considering the two more inclusive categories—rural and urban, that is, population less than or greater than 2,500—the incidence rate of cervical cancer in urban towns was 48 percent greater than that in rural towns. In general, the risks for cervical cancer increased steadily with increasing population, exceeding unity only in the six towns with more than 50,000 inhabitants; the risks for corpus cancer seem to be unrelated to population size.

Population density is even more strongly associated with the incidence of cervical cancer than is population size. Table 4 shows a fairly regular progression of incidence from a low value of 68 percent of expected cases in the least densely settled areas to a high value of 120 percent in the most densely settled areas. The data show no relation between corpus cancer incidence and population density.

Industrialization

Association of extent and type of industrialization with incidence of uterine cancer has been noted in England and Wales, in Sweden, and in a previous study of a sample of Connecticut towns. Wilder (*9*) studied the distribution of cancer of various sites among Connecticut towns of three industrial classes similar to those de-

Table 4. Observed and expected numbers of uterine cancers in Connecticut, by population density [1] and principal industry [2] of towns, 1935–51

Population density and industrial class	Number of towns	Cervix [3]			Corpus [4]		
		Observed cases	Expected cases	Ratio O/E [5]	Observed cases	Expected cases	Ratio O/E [5]
All classes	169	3,210	3,210.0	1.00	3,010	3,010.0	1.00
Population density:							
0–100	82	168	247.0	.68	254	248.9	1.02
100–199	30	170	210.1	.81	199	200.3	.99
200–499	27	399	405.6	.98	419	389.9	1.07
500–999	13	446	492.6	.91	394	456.9	.86
1,000–4,999	14	991	996.8	.99	951	921.3	1.03
5,000 and over	3	1,032	857.4	1.20	792	793.2	1.00
Class I	76	232	341.5	.68	311	323.4	.96
Population density:							
0–100	60	88	130.0	.68	137	130.3	1.05
100–199	9	35	50.5	.69	42	47.9	.88
200–499	3	23	34.2	.67	27	31.1	.87
500 and over	4	86	126.8	.68	105	114.1	.92
Class II	39	575	569.8	1.01	566	551.7	1.03
Population density:							
0–100	15	56	78.5	.71	77	79.3	.97
100–199	10	75	88.6	.85	72	84.1	.86
200–499	10	180	157.5	1.13	173	151.8	1.14
500 and over	4	264	245.2	1.08	244	236.5	1.03
Class III	54	2,399	2,298.2	1.04	2,132	2,135.4	1.00
Population density:							
0–100	7	24	38.5	.62	40	39.3	1.02
100–199	11	60	71.0	.85	85	68.3	1.24
200–499	14	196	213.9	.92	219	207.0	1.06
500 and over	22	2,119	1,974.8	1.07	1,788	1,820.8	.98

[1] Per square mile.
[2] As reported in 1940.
[3] Four cases for which residence of patient is unknown excluded from distribution by town but included in expected value and totals.
[4] One case for which residence of patient is unknown excluded from distribution by town but included in expected values and totals.
[5] Ratio of observed to expected cases.

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fined below. His findings on uterine cancer, based on 1,344 uterine cases diagnosed during 1947–50, showed cervical cancer incidence to be higher in manufacturing than in nonmanufacturing towns, with little interclass variation in corpus cancer incidence. His data, which did not include the rural segment of class III towns, showed the highest risks for both types of uterine cancer to be in the urban segment of class II, with no extreme urban-rural variation in that group. In England and Wales (*4*), seaports and textile towns, where many women were employed, were found to have excessive incidence rates for cervical cancer. In Sweden (*13*) incidence rates in industrial areas were higher than those in agricultural areas.

To examine the association between type of industry and incidence of uterine cancer, we have grouped the towns of Connecticut according to the principal industry reported in 1940 (*14*). The three mutually exclusive classes were defined as follows:

I. Nonmanufacturing towns, in which the principal industries reported were agriculture, fishing, quarrying, and lumbering. The one town which was listed as principally residential is included in this category.

II. Towns for which the manufacture of paper, paper products, textiles, and textile products were listed as the principal industries.

III. Industrial towns other than those in class II. The principal industries in this class were the manufacture of rubber, metal, metal products, machinery, and chemicals.

Data for towns in the three industrial classes have been broken down according to population density in table 4. For cervix, ratios of observed to expected cases were well below unity for towns falling either in the low population density group or in industrial class I, while the highest rates were found for towns in industrial classes II and III having population densities of 500 or more per square mile. There were no significant differences between industrial classes II and III in any population density group. The ratios for cancer of the uterine corpus displayed no significant pattern of variation. It would be interesting to know what etiological agents of cervical cancer require a combination of high population density with industrialization and are to be found to the same extent in industrial environments as different as classes II and III. The lack of information on which to base a more detailed classification of towns by predominant industry and other characteristics prevents the development of additional leads in the present study.

Survival Rates and Population Density

The two most widely used indices of the distribution of cancer are incidence rates and mortality rates. Each is a well-defined measure of a particular kind of risk, and each has its own field of application. The use of mortality rates as substitutes for incidence rates in epidemiologic studies may lead to errors in interpretation if there are wide variations in the proportions of patients dying with the disease in question. Only by examining survival rates can the compatability of incidence and mortality studies of a given population be determined.

Table 5 shows crude 5-year survival rates for cervical and corpus cancer patients by the population density of the patients' towns of residence. Cases reported only by death certificates are excluded, but their inclusion would not significantly change the pattern of survival rates. The data in table 5 indicate that for this series study of the patterns of uterine cancer incidence and mortality rates would lead to essentially the same conclusions.

Despite the large number of cases in this study the standard errors of the calculated sur-

Table 5. Five-year survival rates for cancer of the uterine cervix and corpus, by population density of town of residence, Connecticut, 1935–51

Population density [1]	Cervix		Corpus	
	5-year survival rate (percent)	Standard error of rate [2] (percent)	5-year survival rate (percent)	Standard error of rate [2] (percent)
0–99	36. 9	4. 0	47. 8	3. 9
100–199	41. 7	4. 0	57. 2	4. 2
200–499	40. 3	2. 6	57. 3	2. 9
500–999	43. 6	2. 5	56. 0	2. 8
1,000–4,999	40. 7	1. 6	54. 1	1. 8
5,000 and over	42. 6	1. 6	50. 1	2. 0

[1] Per square mile.

[2] Approximate 95 percent confidence limits for each survival rate are included in a range of twice the standard error above and below the calculated rate.

vival rates are so large that more specific conclusions may be in error. However, the data suggest that uterine cancer patients from sparsely populated areas have somewhat poorer prognoses than those from more densely settled areas. The small differences in observed survival rates, if real, may be due to differences in stage of disease, quality of treatment, or other factors. Further comparisons of survival experience in high and low incidence areas would be of interest but would require a larger series of patients than that described here.

Summary

Within the State of Connecticut incidence rates of cervical cancer display some significant patterns of interarea variation; no such variation for corpus cancer could be demonstrated. Cervical cancer incidence was highest in industrial towns of high population density, and was substantially lower in rural areas and in industrial areas of low population density. Standard metropolitan districts were too heterogeneous to demonstrate the variability in cervical cancer incidence associated with population density. No consistent relationships in rates for contiguous towns could be demonstrated for either form of uterine cancer. These findings are in general agreement with previously reported data on the epidemiology of uterine cancer.

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New State Laws on Migratory Labor

A summary of new State legislation relating to migratory labor appears in the November 1961 issue of *Migratory Labor Notes*, issued by the President's Committee on Migratory Labor. Secretary of Labor Arthur Goldberg is chairman. Ten States adopted 23 new or revised laws. At press time, four legislatures were in session with bills pending.

Program Notes

Several States have transferred or consolidated health programs.

California, in reorganizing the State government, created a health and welfare agency consisting of the department of social welfare, mental hygiene, and public health.

New Hampshire consolidated its health and welfare departments into a new State department of health and welfare directed by a commissioner of health and welfare, and created within the department a division of public health services consisting of the board of health, water pollution commission, commission on alcoholism, and the State sanatorium.

Indiana reestablished its State board of health and the stream pollution control board on the same basis under which they existed prior to 1953.

Maryland abolished its board of health and the mental hygiene advisory board, and the mental hygiene board of review, and created a State board of health and mental hygiene empowered to establish policy for the department of health and the department of mental hygiene.

Nevada assigned its State health department the responsibility for developing and administering preventive and outpatient mental health services, and providing inpatient and outpatient care of mentally ill persons.

Arizona, effective October 1, 1961, transferred the administration of the crippled children's services and supervision of the State hospital for crippled children from the department of public welfare to the newly created State board of crippled children's services.

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"Migrant Farm Labor in New York State," a report by the State interdepartmental committee on farm and food processing labor, is available on request from the State health department.

Annual expenditures for all types of medical care have risen from $3 billion 30 years ago to $25 billion today, according to George Bugbee, president of the Health Information Foundation.

Writing in the September 1, 1961, issue of *Hospitals*, he said private expenditures for hospital care during this period have risen from $400 million to $5.5 billion, representing approximately 30 cents of each dollar spent for medical care today.

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Philadelphia will install "blowby" devices on all city cars purchased, starting with the 1962 models. The estimated cost of the devices, including installation, will be about $3–$5 for factory-delivered cars and $10–$15 for used cars. The total cost for the 400 cars expected to be purchased in 1962 will be $1,200–$2,000.

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Code V, a new quarterly newsletter of the health education section of the Florida Public Health Association, is distributed to major industries in the State, health officers and school superintendents, voluntary agencies, and State and territorial directors of public health education.

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A 1-day news media seminar on science and health will be held in Syracuse, N.Y., in June 1962 as part of the State's 58th Annual Health Conference. The purpose of the seminar is to provide representatives of newspapers and radio and television stations throughout the State with background information which can be used in reporting news concerning science and health.

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A law has been passed in California to try to keep "cured" drug addicts from becoming readdicted. Under the law, rehabilitation centers are set up in which both voluntary and involuntary patients are given standard treatment. When the addict is discharged, he must register with the police within 30 days. This registration must be maintained for 5 years, during which he is subject to periodic or surprise tests to determine his readdiction status. If he is found to have become readdicted, he will be returned to confinement.

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The New York City Board of Health has ordered the closing of eight tattoo parlors. Since mid-1959, 30 cases of hepatitis, with one death, were traced to their tattoo needles.

The regulation does not affect tattooing by physicians or osteopaths nor the tattooing of animals.

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Approximately 75,000 power mower accidents occur in the nation each year, according to the U.S. Department of Agriculture. About 90 percent involve the rotary-type mower, 70 percent result from finger-or-toe contact, and 30 percent from flying objects.

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A new division in the National Library of Medicine will be concerned entirely with medical history. The chief, Dr. John B. Blake, will supervise maintenance, development, and application of the Library's historical resources.

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A special venereal disease clinic for 13- to 17-year-old patients has been established by the Philadelphia Department of Public Health following a 6-month study of the teenage venereal disease problem in one health district.

It will offer teenagers special services "to overcome emotional, economic, behavorial, and environmental problems."

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A greaseless substance which repels most mosquitoes, fleas, chiggers, ticks, flies, and gnats is being issued by the Army. It was developed by the Department of Agriculture with Army medical research funds.